Winter 2012-2013 Outlook for Colorado

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Boulder, Colorado
October 28, 2012
Revised
(Slides 34-36)





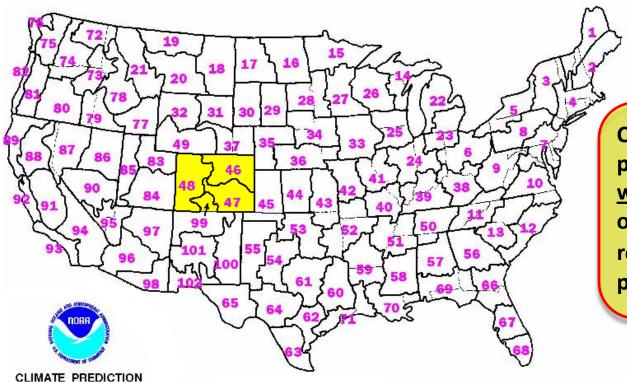
November 2012-January 2013
Temperature and Precipitation
Outlook for Colorado
Issued by the
Climate Prediction Center

Climate Prediction Center Seasonal Outlooks

The National Weather Service Seasonal Climate Outlooks predict the probability of conditions being among the warmest/coldest or wettest/driest terciles of years compared to the period of record 1981-2010.

The outlooks indicate probability of being in three specific categories in reference to the 30-year climatology from 1981-2010. They are above, below and average.

Remember, Climate Predicition Center (CPC) outlooks are made at the scale of the climate megadividions (see the map below).

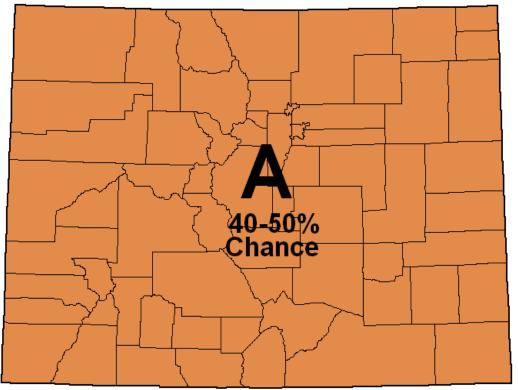


CENTER

Remember...

CPC outlooks do not predict the degree of warmness or coldness, or how wet or dry a region will be; only their probability of occurrence.





One-Month Outlook Temperature Probability 0.5 Month Lead Valid Nov 2012

Made: 18 Oct 2012

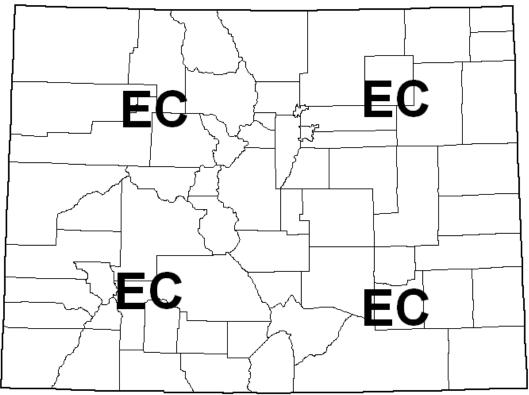
- A Means Above Normal (Average)
- N Means Normal (Average)
- B Means Below Normal (Average)
- EC Means Equal (or Undetermined) Chances for A, N and B

Source: NOAA/Climate Prediction Center

November 2012 Temperature Outlook for Colorado

Climate Prediction Center (CPC) predicts a 40 to 50 percent chance of above-average temperature across all of Colorado during the month of November.

November 2012 Precipitation Outlook for Colorado



One-Month Outlook Precipitation Probability 0.5 Month Lead Valid Nov 2012

Made: 18 Oct 2012

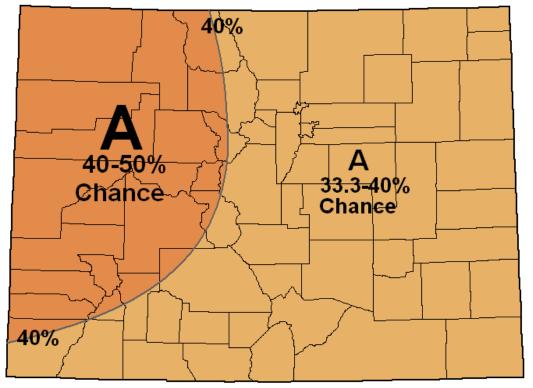
- A Means Above Normal (Average)
- N Means Normal (Average)
- Means Below Normal (Average)
- EC Means Equal (or Undetermined) Chances for A, N and B

Source: NOAA/Climate Prediction Center

November 2012 Precipitation Outlook for Colorado

CPC is predicting an equal or (undeterminable) chance (EC) for above-, below- and nearaverage precipitation across Colorado during November.

November 2012-January 2013 Temperature Outlook for Colorado



Three-Month Outlook Temperature Probability 0.5 Month Lead Valid NDJ 2012 Made: 18 Oct 2012

- A Means Above Normal (Average)
- N Means Normal (Average)
- B Means Below Normal (Average)
- EC Means Equal (or Undetermined) Chances for A, N and B

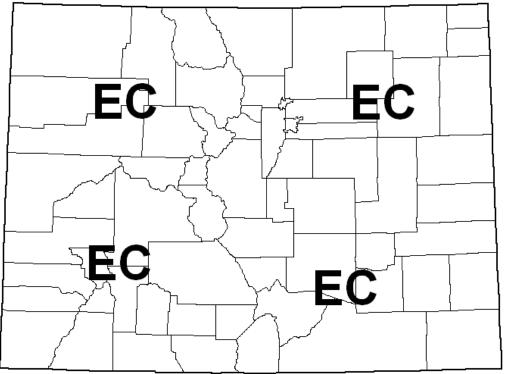
Source: NOAA/Climate Prediction Center

November 2012-January 2013 Temperature Outlook for Colorado

The outlook for November 2012-January 2013 climate season calls for a 40 to 50 percent chance of above-average temperature for the western one-third of Colorado, and a slightly lower chance (a 33.3 to 40 percent) for above-average temperature for the remainder of the state.

Keep in mind, this outlook does not infer any degree of warmness or coldness. It is only a probability that these conditions will happen.

November 2012-January 2013 Precipitation Outlook for Colorado



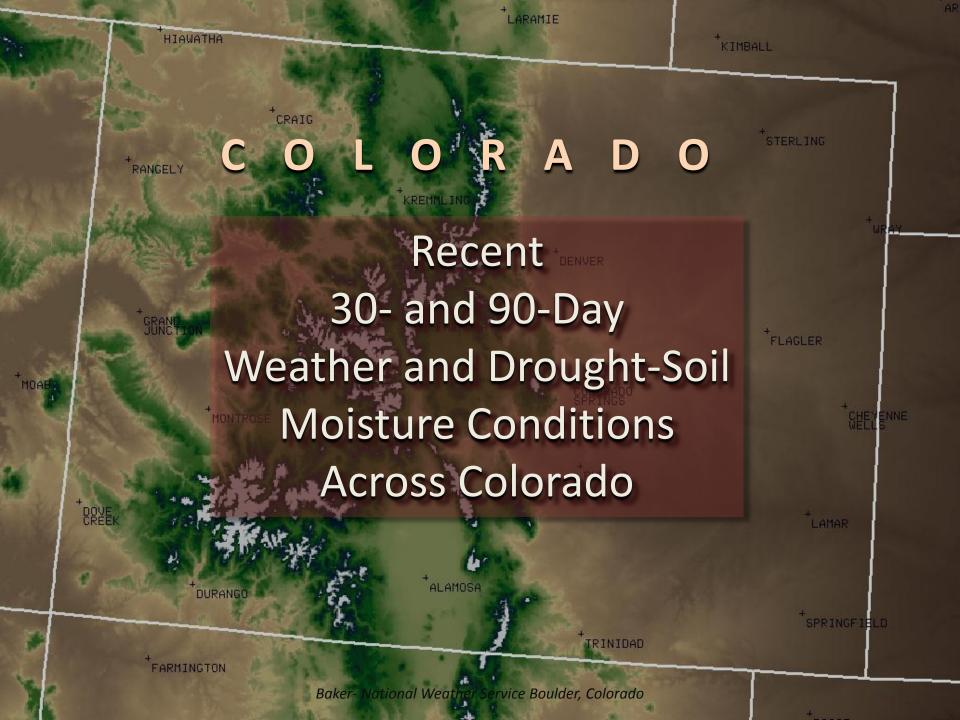
Three-Month Outlook
Precipitation Probability
0.5 Month Lead
Valid NDJ 2012
Made: Oct 18 2012

- A Means Above Normal (Average)
- N Means Normal (Average)
- B Means Below Normal (Average)
- EC Means Equal (or Undetermined) Chances for A, N and B

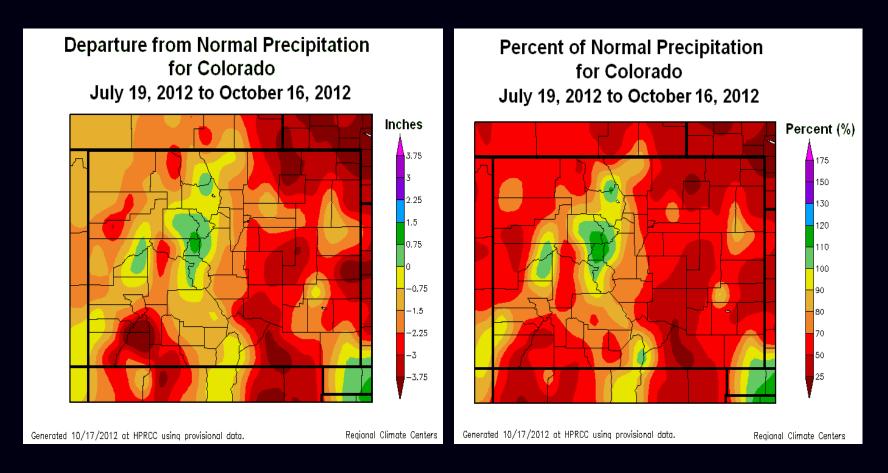
Source: NOAA/Climate Prediction Center

November 2012-January 2013 Precipitation Outlook for Colorado

Lastly, CPC is calling for an equal (or undeterminable) chance (EC) for above-, belowand near-average precipitation across Colorado during the November 2012-January 2013 climate season.

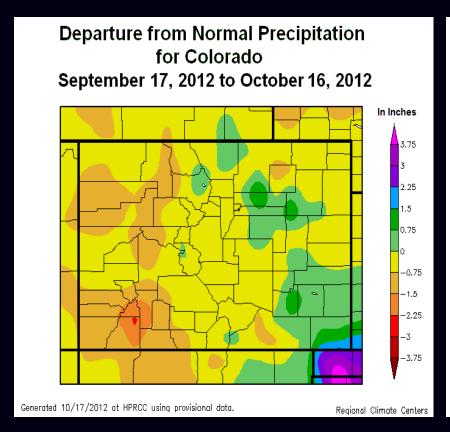


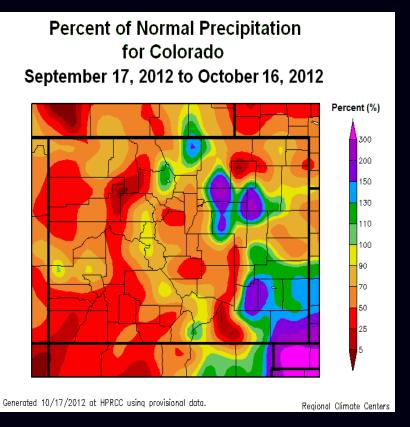
Precipitation for the 90-Day Period Ending October 16, 2012



Precipitation during the recent 90-day period ending October 16th was below to much below average for nearly all of Colorado. Exceptions include the pockets of above average precipitation in the mountains and high valleys of west central Colorado and extreme southeast corner of the state.

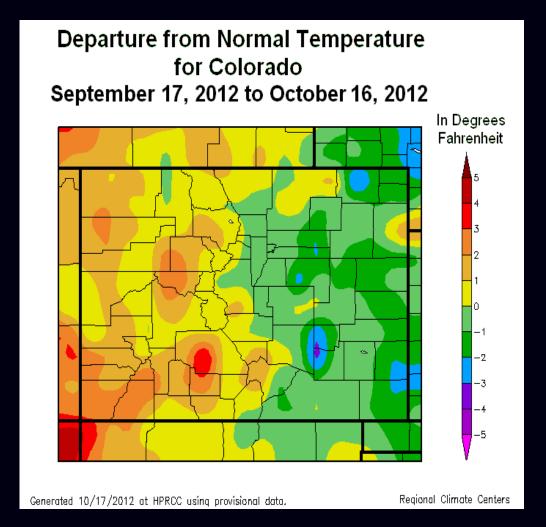
Precipitation for the 30-Day Period Ending October 16, 2012





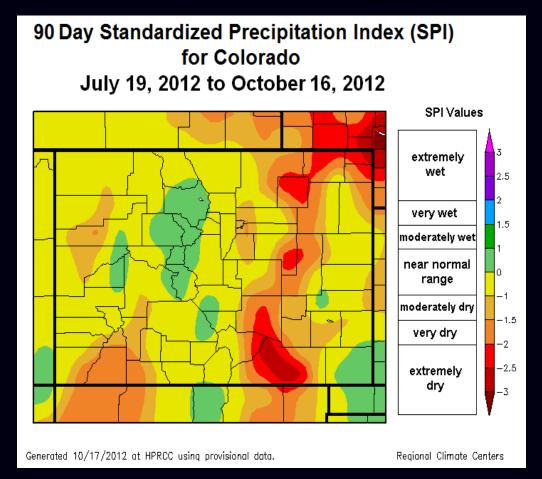
It is evident from this set of maps that there was a significant increase in precipitation during the more recent 30-day period ending October 16th. While portions of western and south central Colorado continued to record below average precipitation, the remainder of the state saw a number of storm events during September and early October that resulted in above to much above average precipitation during this 30 day period.

Temperature for the 30-Day Period Ending October 16, 2012



Temperatures during this latest 30-day period ranged from 1 to 3 degrees F below average in eastern Colorado, to generally 1 to 3 degrees above average across western Colorado. Exceptions include the hot spot in Gunnison County in southwest Colorado and the cold spot just east of Pueblo in southeast Colorado.

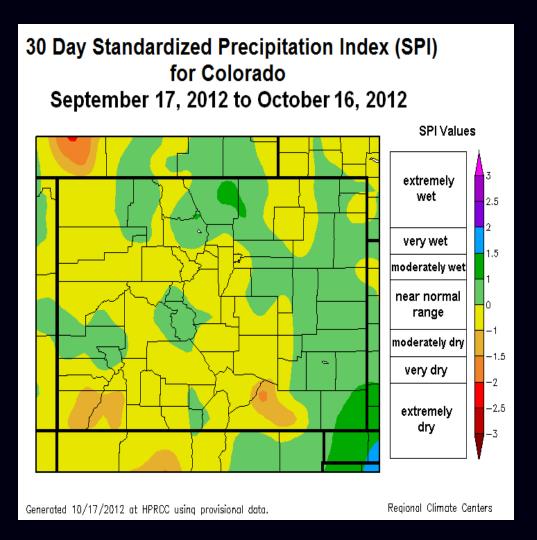
Soil Moisture Conditions for the 90-Day Period Ending October 16, 2012



The Standardized Precipitation Index (SPI) for the recent 90-day period ending October 16, 2012, indicates moderate to very dry conditions across most of Colorado due, in large part, to the lack of precipitation during the first 60 days of this period. However, during the last 30 days of this period, monsoon rains managed to moisten soils in the mountains and high valleys of central Colorado. An uptick in late summer thunderstorm activity also helped to improve soil moisture across the extreme southeast corner of the state.

The SPI was developed to monitor potential short term agricultural and long-term hydrological drought conditions. The SPI is a probability index that considers <u>only</u> precipitation.

Soil Moisture Conditions for the 30-Day Period Ending October 16, 2012



The Standardized Precipitation Index (SPI) for the more recent 30-day period ending October 16, 2012, indicates a sizable improvement in soil moistures for portions of north central and eastern Colorado. There was also some improvement across southwest Colorado largely due to a brief resurgence in monsoon thunderstorm activity during late August and early September. The most noticeable improvement in soil moistures occurred along the northern Front Range around Fort Collins, the far northeast plains, and across the extreme southeast corner of the state.

U.S. Drought Monitor

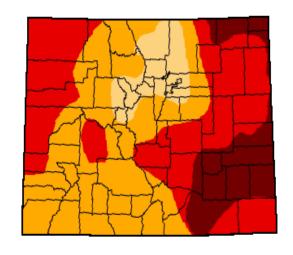
October 16, 2012

Valid 7 a.m. EST

Colorado

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	100.00	91.36	51.05	14.01
Last Week (10/09/2012 map)	0.00	100.00	100.00	91.93	53.07	14.02
3 Months Ago (07/17/2012 map)	0.00	100.00	100.00	100.00	70.46	1.77
Start of Calendar Year (12/27/2011 map)	67.79	32.21	24.98	14.94	0.04	0.00
Start of Water Year (09/25/2012 map)	0.00	100.00	100.00	100.00	61.75	16.89
One Year Ago (10/11/2011 map)	62.59	37.41	27.42	19.99	6.46	0.57



Intensity:





The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://droughtmonitor.unl.edu



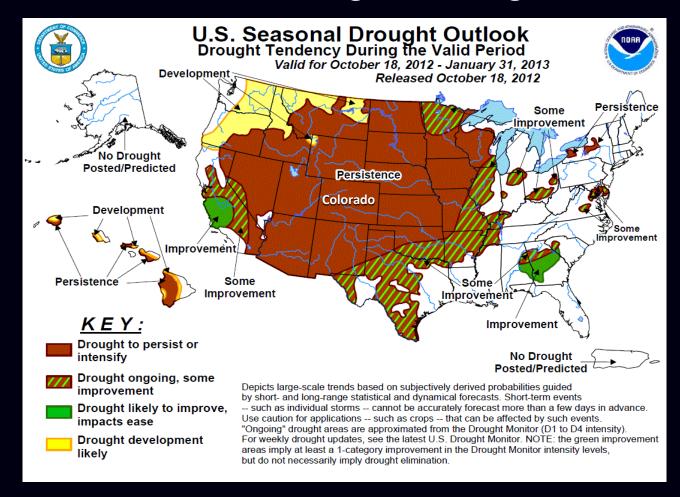
Released Thursday, October 18, 2012 Matthew Rosencrans, NOAA/NWS/NCEP/CPC

Current Drought Conditions

As of October 16, 2012, much of eastern and northwestern Colorado continued to experience extreme (D3) to exceptional (D4) drought conditions. However this is a sizable reduction in areal coverage from just 30 days ago.

The most noticeable improvement in drought conditions occurred across north central Colorado, particularly along the Front Range, where slow moving storm systems in September and early October brought soaking rainfall to the plains and snowfall to the higher elevations.

What's the Outlook for Drought in Colorado During the Coming Months?



The drought outlook for the United States for the period October 18 to January 31, 2013.

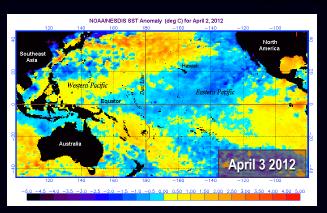
Drought conditions across Colorado are forecast to persist during this period.

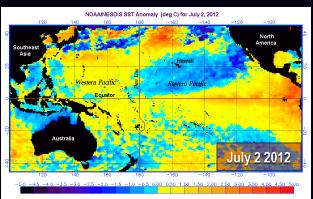
For an outlook for the entire U.S., go to www.cpc.ncep.noaa.gov/products/expert assessment/season drought.gif.

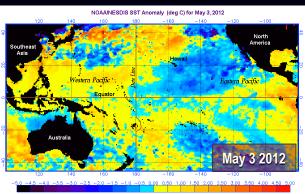


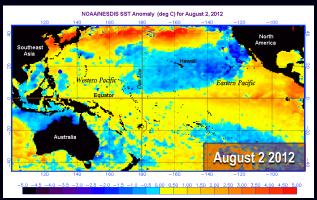
Baker - National Weather Service Boulder, Colorado

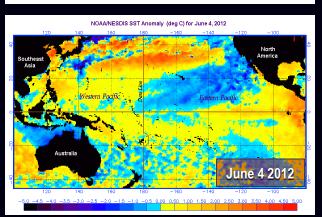
El Niño Watch Continues

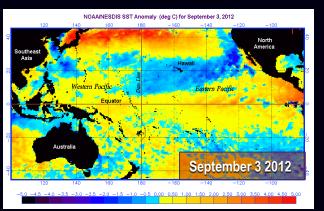






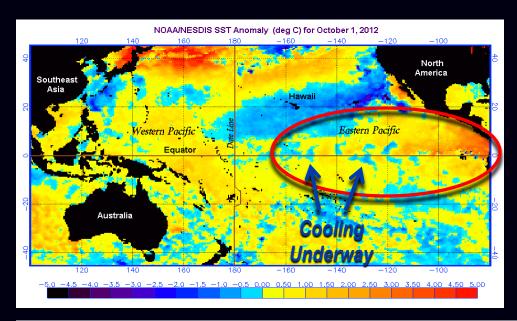




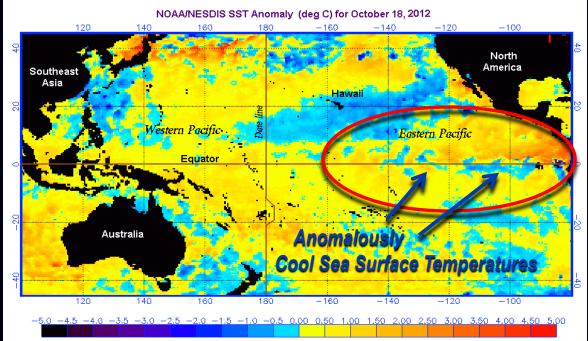


From early spring through the end of September of this year, sea surface temperature (SST) anomalies (temperature departures from normal) grew increasingly positive across the eastern tropical Pacific Ocean. Notice the westward expansion (chronologically from the upper left map to the lower right map) of positive SST anomalies (yellow and red shades) along the equator.

This greater than average warming was most pronounced along the southwest coast of Central America and the northwest coast of South America during July and August. SST anomalies in this region of the eastern Pacific exceeded 3 deg C.



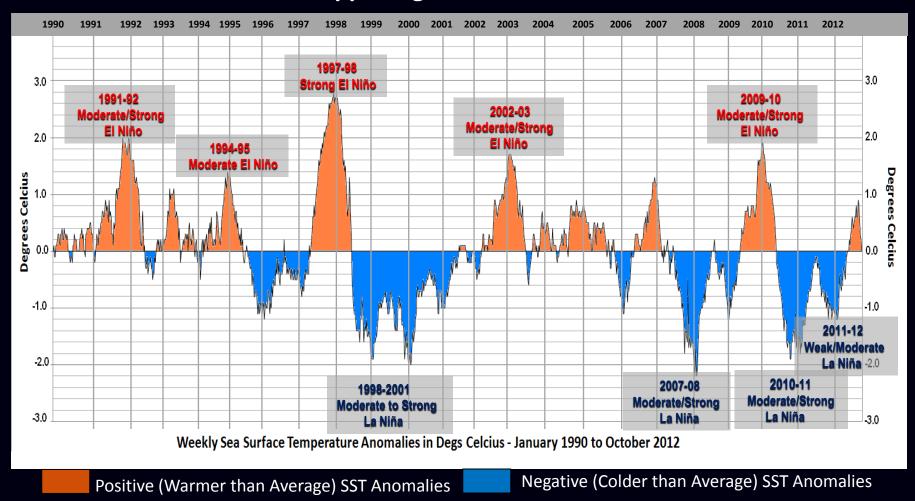
In recent weeks, however, the warmer than average surface waters in the tropical eastern Pacific Ocean have begun to cool.



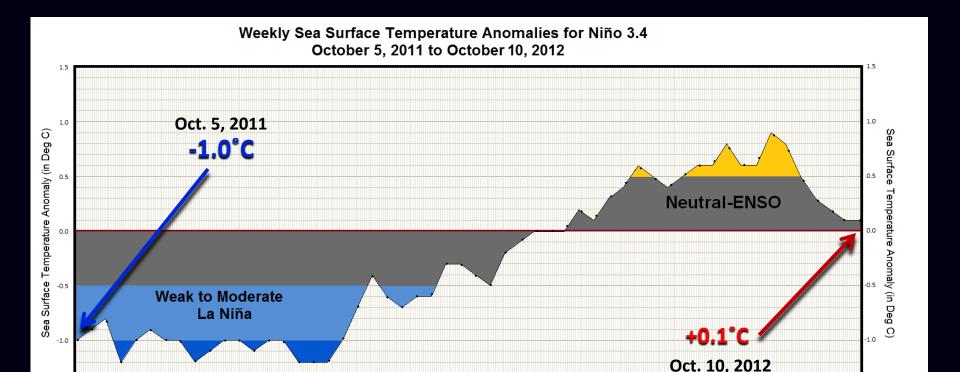
This reduction in positive temperature anomalies has been most evident along the equator east of the 145° longitude. SSTs have actually fallen to slightly below average in this region. (Note the pockets of blue shading along the equator on the adjacent maps.)

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Is What is Happening in the Pacific Unusual?



No. For instance, since 1990 there have been frequent oscillations in sea surface temperatures (SSTs) above and below average. These so-called oscillations are what climate scientists use to predict the alternating phases of the El Nino/Southern Oscillation or ENSO in the Indian and Pacific Oceans. The phase when SSTs become warmer than 0.45C is referred to as an El Niño. When SSTs anomalies fall below -0.45C, we refer to this negative or cold phase as a La Niña.



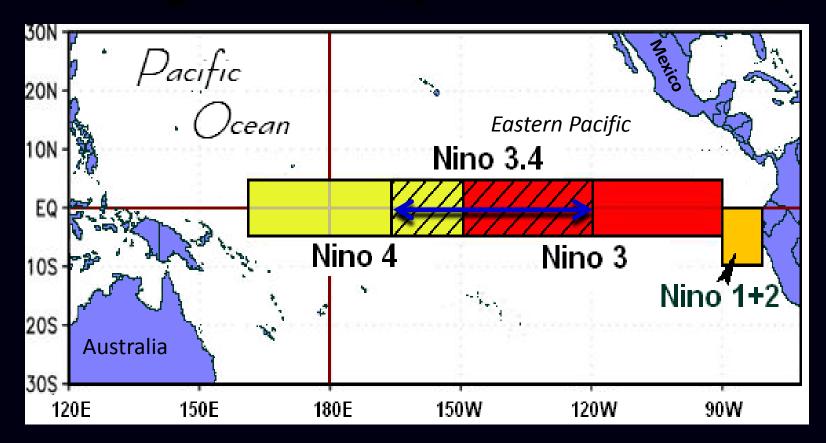
Source: NOAA/Climate Prediction Center

2011

2012

From February to June of this year, the negative weekly SST anomaly for ENSO 3.4 weakened, and by July had risen into positive territory. By the middle of September, however, the ENSO 3.4 SST anomaly steadily weakened to a value of 0.1 by October 3rd where it remained through October 10th. Even though the weekly SST anomaly for ENSO 3.4 exceeded 0.45 deg C during July, August and early September of this year, the criteria of five consecutive months of SST anomalies of at least 0.45 deg C employed by the Climate prediction Center to identify a warm phase ENSO or El Niño was not met.

Niño Regions in the Equatorial Pacific Ocean



Niño 3.4 – The principal region in the eastern Equatorial Pacific Ocean used by the Climate Prediction Center (CPC) for monitoring, assessing and predicting ENSO (hatched region on the above map).

The Oceanic Niño Index - ONI

Year	DJF	JFM	FMA	МАМ	АМЈ	МЈЈ	JJA	JAS	ASO	SON	OND	NDJ
2000	-1.7	-1.5	-1.1	-0.9	-0.8	-0.7	-0.6	-0.5	-0.5	-0.6	-0.8	-0.8
2001	-0.7	-0.6	-0.5	-0.3	-0.2	-0.1	0.0	0.0	-0.1	-0.2	-0.2	-0.3
2002	-0.2	0.0	0.1	0.3	0.5	0.7	0.8	0.8	0.9	1.2	1.3	1.3
2003	1.1	0.8	0.4	0.0	-0.2	-0.1	0.2	0.4	0.4	0.4	0.4	0.3
2004	0.3	0.2	0.1	0.1	0.1	0.3	0.5	0.7	0.7	0.7	0.7	0.7
2005	0.6	0.4	0.3	0.3	0.3	0.3	0.2	0.1	0.0	-0.2	-0.5	-0.8
2006	-0.9	-0.7	-0.5	-0.3	0.0	0.1	0.2	0.3	0.5	0.8	1.0	1.0
2007	0.7	0.3	-0.1	-0.2	-0.3	-0.3	-0.3	-0.6	-0.9	-1.1	-1.2	-1.4
2008	-1.5	-1.5	-1.2	-0.9	-0.7	-0.5	-0.3	-0.2	-0.1	-0.2	-0.4	-0.7
2009	-0.9	-0.8	-0.6	-0.2	0.1	0.4	0.5	0.6	0.7	1.0	1.4	1.6
2010	1.6	1.4	1.1	0.7	0.2	-0.3	-0.8	-1.2	-1.4	-1.5	-1.5	-1.5
2011	-1.4	-1.3	-1.0	-0.7	-0.4	-0.2	-0.2	-0.3	-0.6	-0.8	-1.0	-1.0
2012	-0.9	-0.7	-0.5	-0.3	-0.1	0.0	0.1	0.3				

NOAA/CPC Last Update 08-06-12

During the July-September 2012 climate season, the ONI of 0.3 is an indication of neutral ENSO conditions.

El Niño: ONI higher than +0.45 Neutral ENSO: ONI of -0.45 to +0.45

La Niña: ONI lower than -0.45

The ONI is based on sea surface temperature (SST) departures from average in the Niño 3.4 region of the eastern tropical Pacific Ocean. It is the principal measure used by NOAA's Climate Prediction Center (CPC) for monitoring, assessing and predicting El Niño/Southern Oscillation (ENSO.)

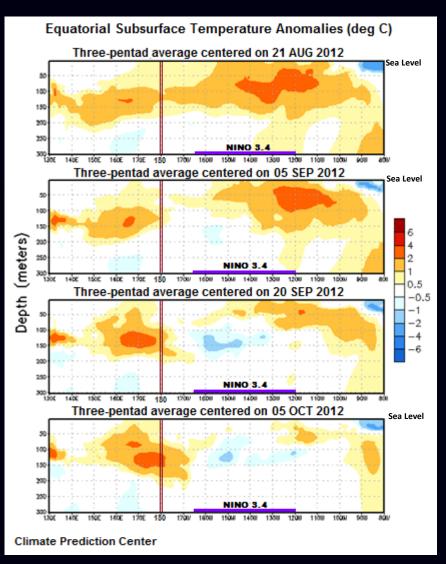
ONI is defined as the three-month running mean SST departures in the Niño 3.4 region of the Pacific.

ONI is used to place current ENSO and non-ENSO events into a historical perspective.

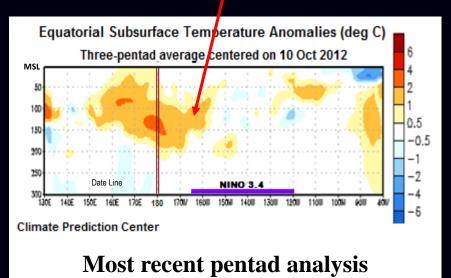
CPC's operational definitions of El Niño and La Niña are keyed to the ONI index.

For historical purposes, warm and cold phases of ENSO (the red and blue colored numbers) are defined when the threshold is met for a minimum of 5 consecutive overlapping 3-month seasons.

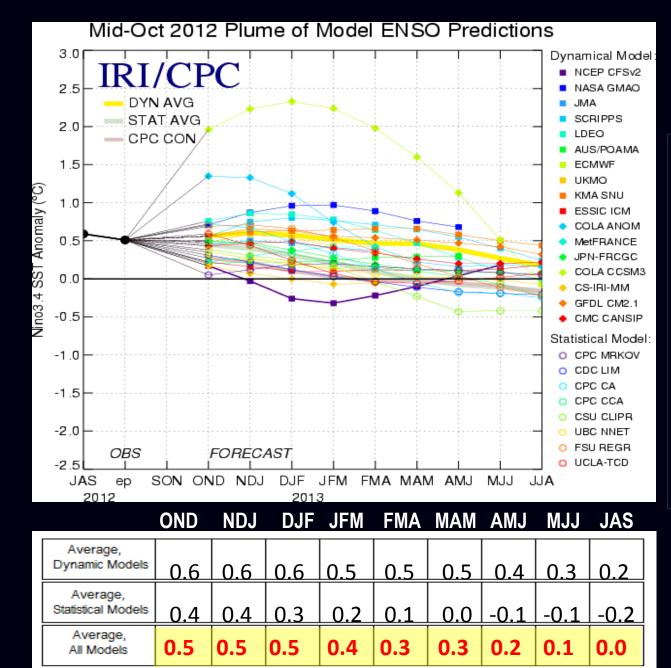
Recent Changes in Sub-Surface Temperature Departures (°C) in the Equatorial Pacific



- During the last two months, positive subsurface (upper 300 meter) temperature anomalies have weakened across the equatorial Pacific.
- However, in the past month, the region of positive subsurface temperature anomalies near the Date Line has grown and expanded eastward to region NINO3.4.



Longitude



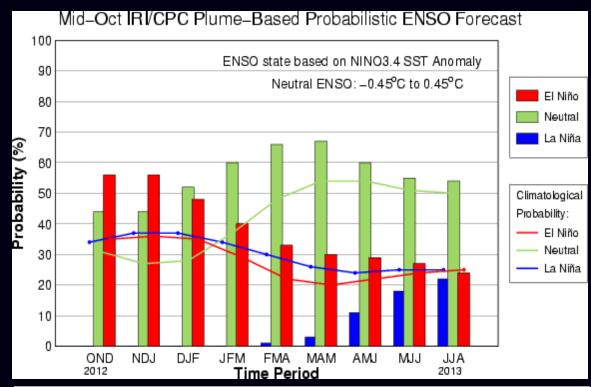
What's the Outlook for ENSO This Winter?

Nine of the 17 dynamical climate models used to forecast ENSO predict a weak El Niño during the 2012-2013 winter season. One model goes so far as to predict moderate El Niño, and another a strong El Niño. The remaining six dynamical models predict neutral ENSO conditions during the November 2012-January 2013 climate season.

A majority of the statistical climate models also predict **neutral ENSO** conditions during the upcoming winter season.

See the table provides the seasonal SST anomaly averages for Niño 3.4 through the summer of 2013.

Source: The International Research Institute for Climate and Society (IRI)



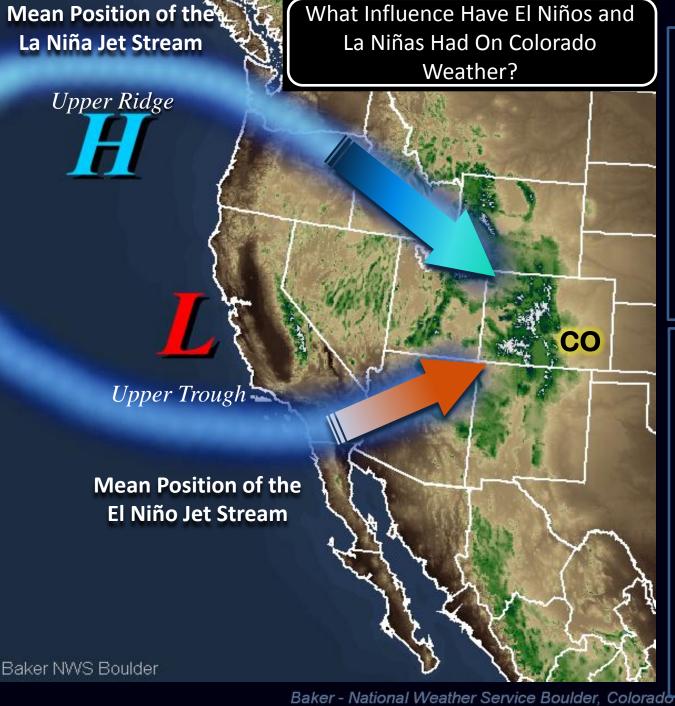
From a different perspective, the IR/CPC plume-based probabilistic ENSO forecast predicts slightly better than a 50 percent chance of El Niño during the overlapping 3-month periods October-December and November-January. For the same period, the forecast is for a 44 percent chance of neutral ENSO conditions.

IRI Probabilistic ENSO Prediction for NINO3.4 Region						
Season	La Niña	Neutral	El Niño			
OND 2012	~0%	44%	56%			
NDJ 2013	~0%	44%	56%			
DJF 2013	~0%	52%	48%			
JFM 2013	~0%	60%	40%			
FMA 2013	1%	66%	33%			
MAM 2013	3%	67%	30%			
AMJ 2013	11%	60%	29%			
MJJ 2013	18%	55%	27%			

Even though El Niño conditions have yet to appear as of the end of October, an El Niño watch remains in effect because there's still a window for it to emerge in the weeks to come.

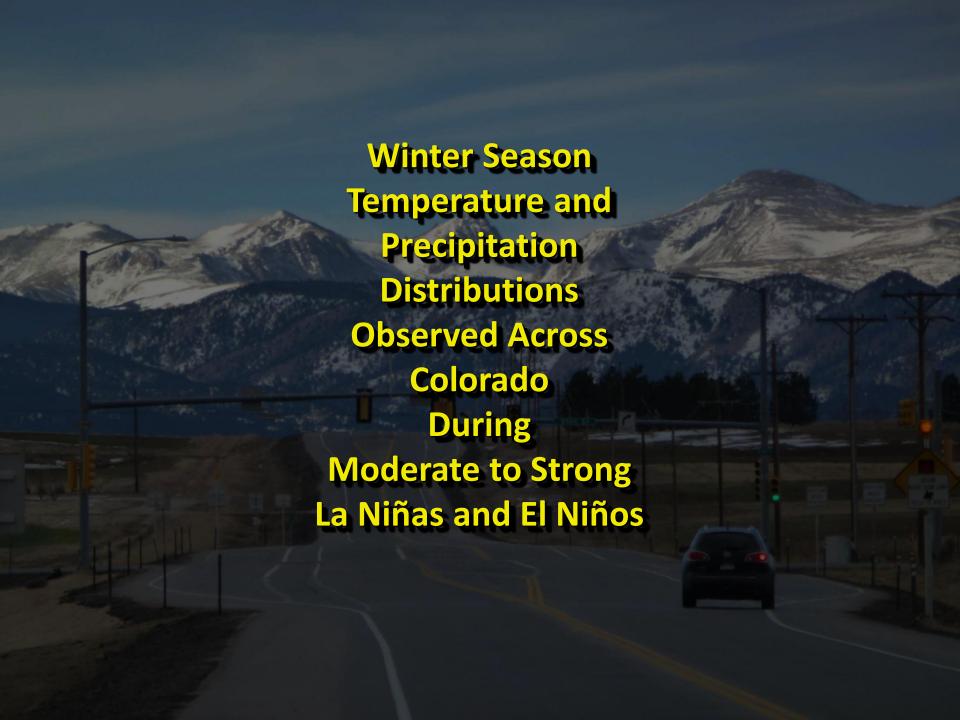
Source: The International Research Institute for Climate and Society (IRI)

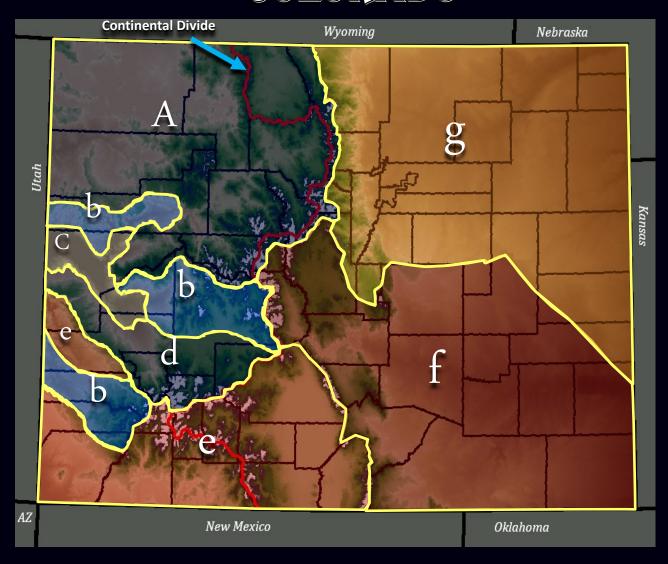
Colorado Winter Weather **Patterns** Commonly **Associated ENSO and Non-ENSO Conditions**



to strong El Niños, a strong
Pacific jet stream will often be
seen steering wet and windy
storm systems from the Desert
Southwest and across the
southern Rocky Mountain
Region. Such a storm track
usually results in bouts of
heavy precipitation and strong
winds mainly for southern and
eastern portions of Colorado.

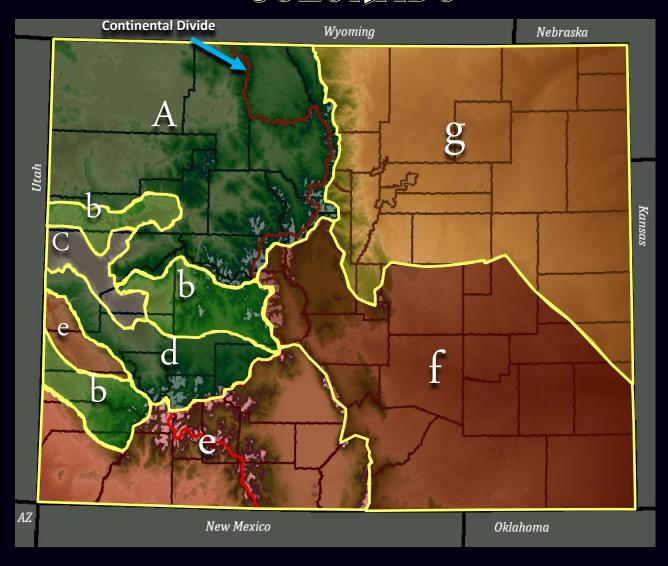
During the winter and spring of moderate to strong La Niñas, a powerful Pacific jet stream will often transport very wet and windy storm systems from the Pacific Northwest down across to the central Rocky Mountain region. These potent storm systems often produce periods of heavy snowfall and strong and gusty winds for northern and western Colorado, and strong, potentially damaging winds for the state's Front Range and high plains.





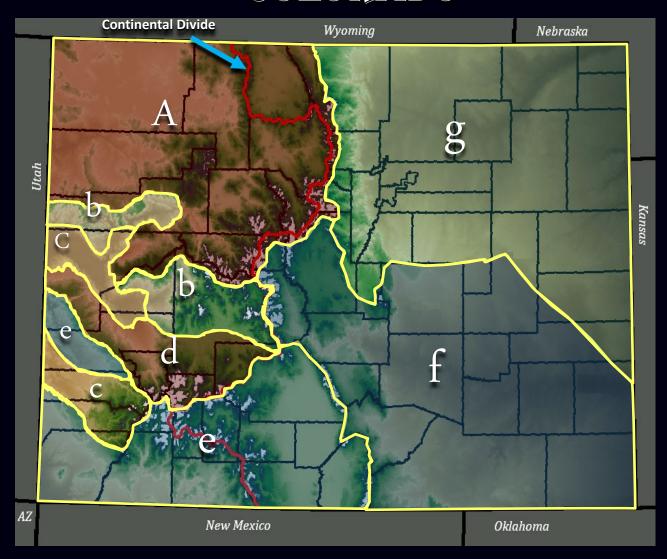
Winter Season
Temperature
Distribution
During Moderate
to Strong
La Niñas

- A Below to Much Below Average
- B Below Average
- C Near to Below Average
- D Below Average
- E Above Average
- F Above to Much Above Average
- G Near to Above Average



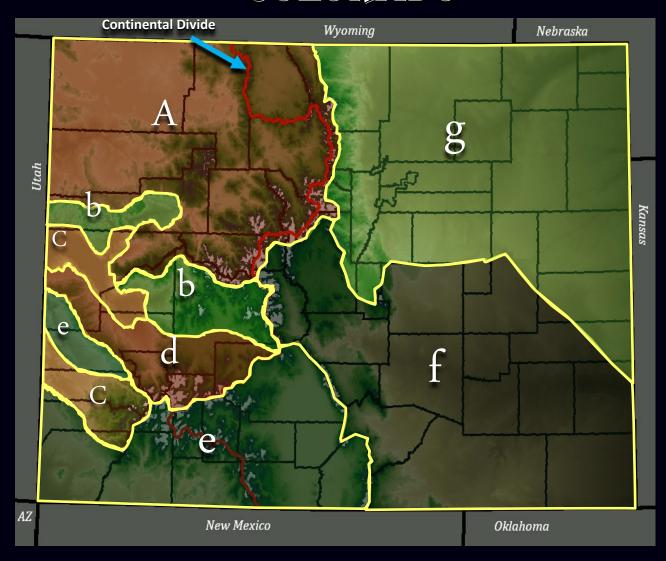
Winter Season
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- A Above to Much Above Average
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- E Below Average
- F Below to Much Below Average
- G Near to Below Average



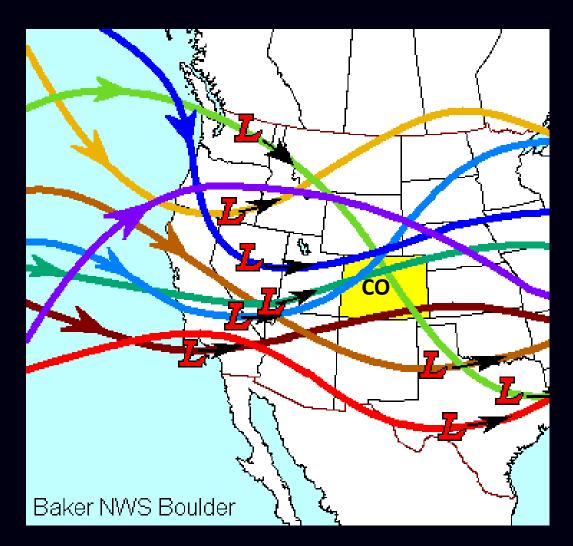
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Winter Season
Precipitation
Distribution
During Moderate
to Strong
El Niños

- A Below to Much Below Average
- B Near to Above Average
- C Near to Below Average
- D Below to Much Below Average
- E Above Average
- F Above to Much Above Average
- G Near to Above Average



So, what influence do weak
El Niños and Non-ENSO
Conditions have on
winter weather across
Colorado?

Based on a review of major storm tracks during weak El Niños of the past 30 years, Colorado will probably see a number of storm systems periodically tracking across the state. However, these storms are likely to be less intense and of shorter duration than those often associated with stronger ENSO events.

ENSO and Non-ENSO Snowfall Frequency For Northeast Colorado Since January 1950



Interpreting the Table

Phase of ENSO and non-ENSO	Total Number of Snowfall Days	Percentage of Total Snowfall Days	Total Number and Percentage of Snowfall Days Standardized to All ENSO and Non-ENSO Episodes Since 1950		
El Nino	92	34.5%	109.4	41.0%	
La Nina	96	36.0%	88.2	33.0%	
Neutral	79	29.6%	69.4	26.0%	

In the next two slides we will examine the frequency of days with significant (5 and 10 inch) snowfalls at four locations in northeast Colorado; Denver, Boulder, Fort Collins and Sterling (see map) during El Niño, La Niña and non-ENSO or neutral ENSO episodes since January of 1950. Since 1950, there has been 17 El Niños, 22 La Niñas and 23 non-ENSO or ENSO-neutral episodes.

In the tables on the following slides, values presented in the first two columns represent the total number and the percentage of days with at least 5 and 10 inches of snow for each location since 1950. Values in the second two columns represent the total number and the percentage of 5 and 10 inch snowfall days standardized to the total number of El Niños, La Niñas and neutral-ENSO episodes since 1950. These standardized values represent more accurately the association between significant snowfall at these locations and the different phases of ENSO and non-ENSO.

ENSO and Non-ENSO Snowfall Frequency For Denver and Boulder From 1950 to 2012

Days With Snowfall of at Least 5.0 Inches

Denvei		Standardized Values		
El Nino	33	26.2%	40.3	32.0%
La Nina	42	33.3%	39.7	31.5%
Neutral	51	40.5%	46	36.5%

Days With Snowfall of at Least 10.0 Inches

Denver	•	Standardized Values		
El Nino	7	31.8%	8.4	38.2%
La Nina	6	27.3%	5.6	25.5%
Neutral	9	40.9%	8.0	36.4%

Snowfalls of at least 5 inches in Denver (standardized for all ENSO and non-ENSO periods since 1950) occurred most often (36.5 percent of the time) during non-ENSO or ENSO neutral conditions. Whereas days with at least 10 inches of snow in Denver occurred most often (38.2 percent of the time) during El Niño events. However, big El Nino snowfalls in Denver are only slightly more frequent (less than 2 percent) than comparable snowfalls during La Niña.

Days With Snowfall of at Least 5.0 Inches

Boulde	r	Standardized Values		
El Nino	92	34.5%	109.4	41.0%
La Nina	96	36.0%	88.2	33.0%
Neutral	79	29.6%	69.4	26.0%

Days With Snowfall of at Least 10.0 Inches

Boulde	r	Standardized Values		
El Nino	26	42.6%	30.2	49.5%
La Nina	19	31.1%	17.1	28.0%
Neutral	16	26.2%	13.7	22.5%

Snowfalls of at least 5 inches in Boulder (standardized for all ENSO and non-ENSO periods since 1950) occurred most often (41 percent of the time) during El Niño episodes. Days with at least 10 inches of snow also occurred with greater frequency (49.5 percent of the time) during El Niños. The sizable difference in the number of 5 and 10 inch snowfall days in Boulder during El Niños, La Niñas and non-ENSO periods is significant.

ENSO and Non-ENSO Snowfall Frequency For Fort Collins and Sterling From 1950 to 2012

Days With Snowfall of at Least 5.0 Inches

Fort Co	ollins	Standardized Values		
El Nino	39	27.7%	47.4	33.6%
La Nina	52	36.9%	48.8	34.6%
Neutral	50	35.5%	44.8	31.8%

Days With Snowfall of at Least 10.0 Inches

Fort Co	llins		dardized alues	
El Nino	11	40.7%	12.9	47.8%
La Nina	7	25.9%	6.3	23.3%
Neutral	9	33.3%	7.8	28.9%

Snowfalls of at least 5 inches in Fort Collins occurred most often (34.6 percent of the time when standardized for all ENSO and non-ENSO periods since 1950) during La Niña episodes. However, is this only slightly more often than what was observed during past El Niños. Whereas 10 inch snowfalls in Fort Collins occurred with much greater frequency (47.8 percent of the time) during El Niño episodes.

Days With Snowfall of at Least 5.0 Inches

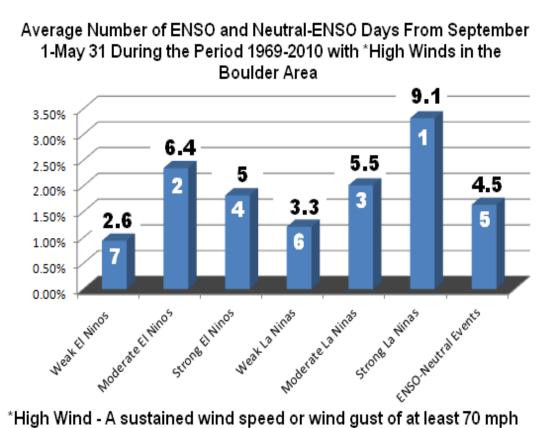
Sterling	g	Standardized Values		
El Nino	17	32.1%	20.4	38.5%
La Nina	13	24.5%	12.2	23.0%
Neutral	23	43.4%	20.4	38.5%

Days With Snowfall of at Least 10.0 Inches

Sterling	g	Standardized Values		
El Nino	2	66.7%	2.2	73.3%
La Nina	0	0.0%	0.0	0.0%
Neutral	1	33.3%	0.8	26.7%

Snowfalls of at least 5 inches in Sterling occurred with the same frequency (38.5 percent of the time when standardized for all ENSO and non-ENSO periods since 1950) during El Niños and ENSO neutral conditions. Unfortunately, the standardized frequencies for 10 inch snowfalls provided above should be treated with caution because of the very small number of 10 inch snowfall events observed in Sterling since 1950.

Is There a Connection Between ENSO and Strong Downslope Winds Along the Colorado Front Range?



*High Wind - A sustained wind speed or wind gust of at least 70 mph and/or any straight line wind that causes considerable property damage.

Baker NWS Boulder

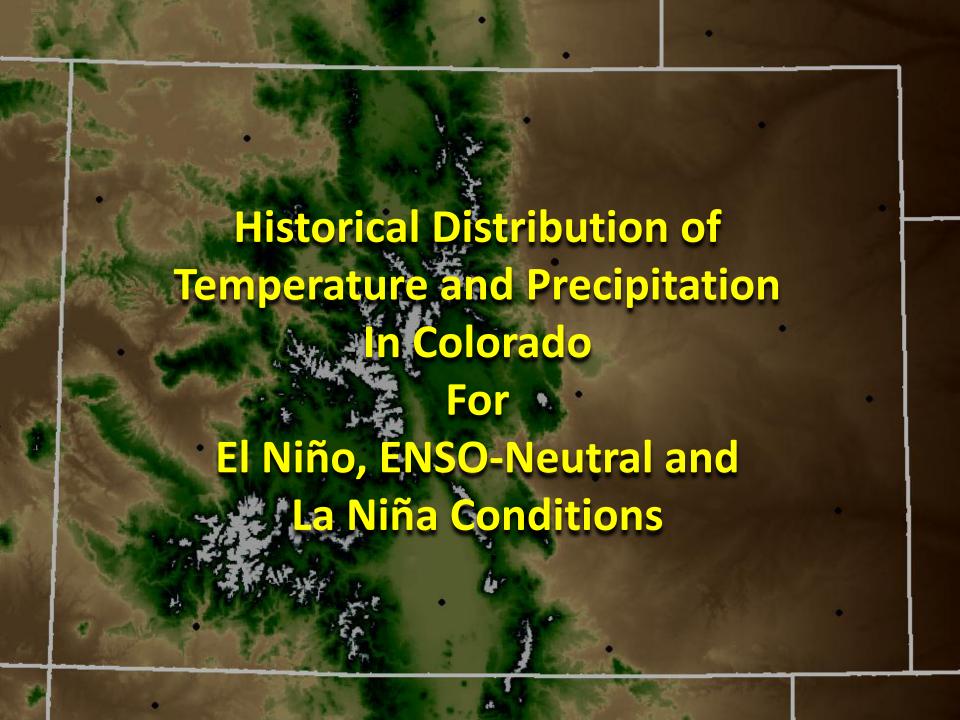
ENSO neutral conditions will probably have more of an influence on Colorado weather (and wind) patterns this winter.

Yes, there does appear to be reasonably good link.

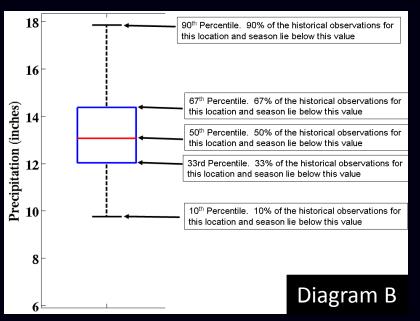
Since 1969, strong, potentially damaging downslope winds, *high winds, occurred most often in the Boulder area during strong La Niñas, followed by strong El Niños.

Conversely, high winds least occurred during weak El Niños and weak La Niñas, followed by periods of neutral ENSO conditions. During neutral conditions, the occurrence of high winds was just slightly less than average.

ENSO neutral conditions will probably have more of an influence on weather (and wind) patterns across Colorado this winter.



Colorado Climate Divisions Northeast Colorado Div. 046 Southeast Colorado Div. 047 Div. 099 Diagram A



Interpreting ENSO Box and Whisker Plots

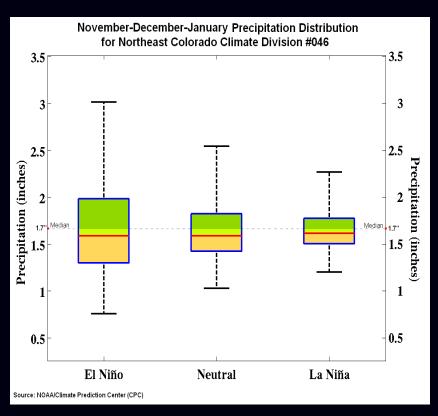
Diagram A is a map of the four climate megadivisions in Colorado used by the Climate Prediction Center (CPC)—Divisions 046, 047,048 and 099.

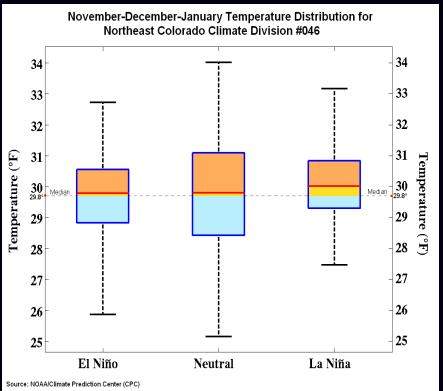
CPC has produced 3-month historical temperature and precipitation distribution plots for the three different ENSO categories —El Niño, La Niña and ENSO-neutral (non-ENSO) conditions for every climate mega-division in the United States.

Diagram B is a description of the ENSO box and whisker analysis plot used by CPC to represent historical temperature and precipitation distributions for each ENSO category pertaining to each climate division.

The red line inside the ENSO box represents the mean or 50th percentile of the data (temperature or precipitation) distribution for each climate division. Approximately 34% of the total observations exist within the ENSO box, and the remaining observations (about 66%) lie outside of the box along the whiskers extending above and below the box.

Precipitation and Temperature Composites (ENSO Box and Whisker Analysis Plots) for the Northeast Colorado Climate Division #046 for November-January



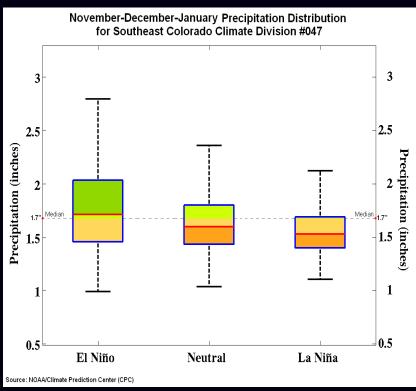


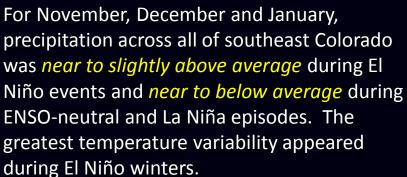
Precipitation across all of northeast Colorado for the 3 month period of November,
December and January was historically *near* average during El Niño, La Niña and neutral ENSO conditions. Precipitation also had a tendency to be more variable during El Niño events.

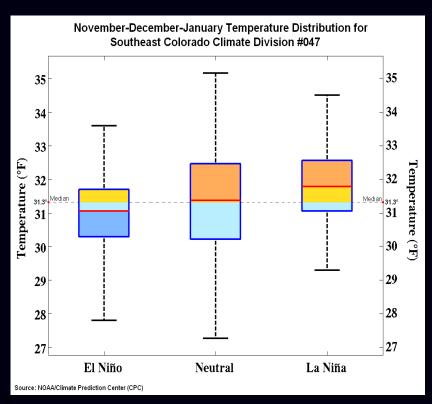
For the same period, temperatures in northeast Colorado were generally *near average* during El Niño and ENSO-neutral conditions and *above average* for La Niña events. Temperatures also had a tendency to be more variable during neutral ENSO conditions.

Baker - National Weather Service Boulder, Colorado

Precipitation and Temperature Composites (ENSO Box and Whisker Analysis Plots) for the Southeast Colorado Climate Division #047 for November-January

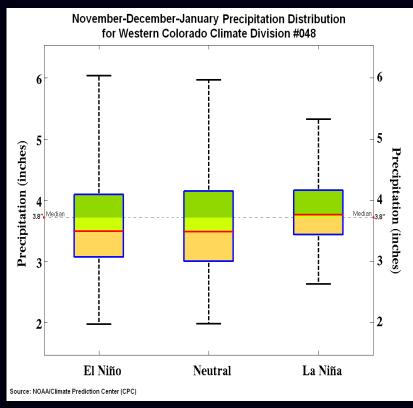




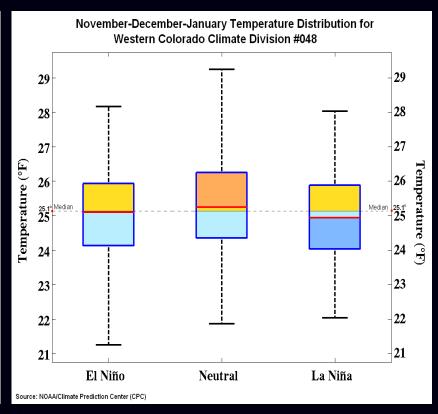


For this same three month period, temperatures were *below average* during El Niños, *near average* during ENSO-neutral, and *above average* during La Niñas. Furthermore, temperature variability was greatest during neutral ENSO conditions.

Precipitation and Temperature Composites (ENSO Box and Whisker Analysis Plots) for the Western Colorado Climate Division #048 for November-January



Precipitation across all of western Colorado during November, December and January was historically *below average* during El Niño and ENSO neutral conditions and *near average* during La Niña events.



Temperatures for the same period were *near* to slightly above average during El Niños and neutral ENSO conditions and slightly below average during La Niña events. Keep in mind, these distributions do not distinguish a difference between ENSO events of weak, moderate and strong intensity.

Concluding Remarks

- An elusive El Niño continues to challenge seasonal climate forecasters with NOAA's Climate
 Prediction Center. Forecasters say a wavering El Niño, expected to have developed by now, makes
 this year's winter outlook less certain than previous years. "This is one of the most challenging
 outlooks we've produced in recent years because El Niño decided not to show up as expected,"
 said Mike Halpert, deputy of NOAA's Climate Prediction Center.
- When El Niño is present, warmer than normal ocean water in the equatorial Pacific Ocean shifts the
 patterns of tropical rainfall eastward that in turn influence the strength and position of the Pacific
 and Polar jet streams and storms over the eastern Pacific Ocean and United States. This climate
 pattern gives seasonal forecasters confidence in how the U.S. winter will unfold. For that reason,
 "an *El Niño watch* remains in effect because there's still a window for it to emerge," according to
 Deputy Director Halpert.
- Other climate factors can also influence winter weather to varying degrees across the country. They include the North Atlantic Oscillation (NAO), the Pacific Decadal Oscillation (PDO), the Madden-Julian Oscillation (MJO), and Pacific Inter-Decadal Oscillation (IPO). The NAO and MJO are difficult to predict more than one to two weeks in advance. Both add uncertainty to the winter outlook, the NAO for the Northeast and Mid-Atlantic and the MJO for western and southern portions of the country.

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2012-2013 Winter Outlook for Colorado – Summarized

- According to Climate Prediction Center's U.S. Winter Outlook, issued October 18, 2012, odds favor warmer-than-average temperatures and an "equal chance" for above-, near-, or below-average precipitation across Colorado during the November 2012 to January 2013 climate season.
- This precipitation outlook <u>does not</u> project where and when snowstorms may hit or provide total seasonal snowfall accumulations. Snow forecasts are dependent upon the strength and track of winter storms, which are generally not predictable more than a week in advance.
- Based on climate records, storm track and jet stream composites, a high wind storm frequency study for the Boulder area, and seasonal climate and ENSO outlooks prepared by NOAA's Climate Prediction Center and The International Research Institute for Climate and Society (IRI), the following weather conditions are more likely to occur in Colorado this winter season during a
- weak El Niño and/or neutral ENSO conditions:
 - 1. Above-average temperatures statewide, with odds favoring northwest and west central portions of the state
 - 2. Slightly above-average precipitation for southern portions of Colorado where storm tracks tend to favor during El Niño events, even weak ones. Otherwise, near- to slightly below-average precipitation is anticipated for the remainder of Colorado. Nonetheless, precipitation-snowfall across Colorado should be greater overall this winter season, compared to the meager amounts observed last winter.

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2012-2013 Winter Outlook for Colorado - continued

- 3. It is reasonable to assume that Colorado will see more storms this winter season compared to last winter. However, these storms are not expected to as intense or as long-lasting as those commonly observed during stronger ENSO episodes.
- 4. One explanation for the weaker, shorter-lived storms this winter season; the storm track normally does not linger for long periods of time over any one particular part of the state during periods of weak ENSO and non-ENSO conditions. The storm track is more likely to persist for days if not weeks at a time over northern Colorado during moderate to strong La Niñas, and for several days at a times across southern Colorado during moderate to strong El Niños.
- 5. Strong, potentially damaging downslope wind storms (known as Chinook and Bora) along the Colorado Front Range are more likely to develop during moderate to strong ENSO events and less often during weak ENSO and non-ENSO periods, as is expected this winter.
- 6. Finally, according to the U.S. Drought Outlook, issued October 18, 2012, those areas of the United States, including Colorado, that were severely impacted by extreme drought over the past year are unlikely to see much relief from drought conditions this winter.